

***TECHNOLOGY BASED
STANDARDS FOR PULP
AND PAPER MILL
WASTEWATER
RELEASES***





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Summary

This document establishes a set of benchmarks for Best Available Technology Economically Achievable (BATEA) for the pulp and paper sector in Alberta for wastewater releases. The release standards apply to new and existing pulp and paper mills (all types) in Alberta.

The standards were adopted after evaluation of technologies and wastewater treatment systems for Alberta pulp and paper mills, and top performing mills throughout the United States and Europe (see Appendix 1). The BATEA standards are the minimum requirements for pulp and paper mill wastewater releases.

More stringent standards may be applied, on a site-specific basis, to maintain water quality objectives. The standards are among the most stringent in the world and reflect the high performance achieved by Alberta pulp and paper mills on a global level.

1.0 Introduction

1.1 Pulp Mill Development in Alberta

The first Kraft pulp mill in Alberta commenced operation in 1957. This mill, located in Hinton, Alberta, released wastewater with a loading of about 30,000 kg/day of Biochemical Oxygen Demand (BOD). In 1973, a second Kraft mill was situated on the Wapiti River. Due to improved treatment and process technologies, the two mills combined released approximately 14,000 kg/day of BOD. There were few changes over the next 15 years.

Within a short period of time thereafter, three mechanical pulp (TMP/2 CTMP) mills and a Kraft mill were proposed to be located on the Athabasca River Basin as well as a fourth Kraft mill to be located on the Peace River. Alberta's pulp production grew from less than 1500 air-dried metric tonnes (ADt) per day at the end of 1987 to over 6000 ADt per day by the end of 1993 (see Table 1). The resulting Environmental Impact Assessments (EIAs), hearings, public meetings, and technical evaluations by the mills and Alberta Environment (AENV) staff indicated that several initiatives needed to be pursued for the projects to proceed in an environmentally acceptable manner. These initiatives included:

- Reduction of oxygen depleting substances (as measured by BOD₅),
- Reduction of persistent toxic substances (e.g. dioxins and furans),
- Installation of reliable wastewater treatment systems, and
- Reduction of water use.

Table 1: Pulp Mill Development Since 1957

Initial Start-up Year	Mill Type	Current Production (2002-2004 RPR in ADt)	Location
1957	Kraft	1340	Hinton
1973	Kraft	1100	Grande Prairie
1988	CTMP	910	Whitecourt
1990	Kraft	1550	Peace River
1990	TMP (newsprint)	830	Whitecourt
1991	CTMP	710	Slave Lake
1993	Kraft	2017	Athabasca

RPR – reference production rate (2002-2004)

1.2 Alberta's Environmental Management Framework

The Alberta Government is shifting away from a "traditional regulator" role towards a strategic "systems approach" to achieving sustainable environmental outcomes. This approach puts the Government in the role of "systems manager" and Alberta Environment as the "systems coordinator". The approach places a high emphasis on shared responsibility with industry, the public, and scientific-technical communities to achieve provincial environmental outcomes.

The systems approach is driven by clear, concrete outcomes, policies, and performance measures. It is dependent on a sound understanding of the environment (watershed,

airshed, and landscape) and an outcome based environmental management system. The Government's Sustainable Resource and Environmental Management (SREM) framework consists of:

- o a systems approach,
- o integrated resource development and environmental management policies,
- o integrated information systems,
- o performance assessment, and

is delivered by a single sector regulator. The single sector regulator is based on a model of one project, one review, one approval, and one appeal. The regulator will consider and integrate environmental outcomes and policies in decisions and approvals, review environmental performance related to outcomes and policies through reporting, inspection and compliance, provide expert analysis and advice as needed by decision-makers and streamlined regulatory processes.

Alberta Environment (AENV), as the systems coordinator for environmental outcomes, will be required to develop environmental policy and standards that support outcomes for the environment and maintain a delivery role for certain activities and sectors. Alberta Environment will collaborate with many departments to integrate the variety of policies and roles that contribute to environmental outcomes. This includes ministries, boards and agencies that regulate activities that affect the environment (e.g. Alberta Sustainable Resource Development, the Alberta Energy and Utilities Board, Alberta Agriculture, and Food and Rural Development) and departments whose mandates and policies have the potential to affect the environment (e.g. Alberta Economic Development, Alberta Energy). Alberta Environment will also work with Alberta Health and Wellness on environment/health linkages and the many parties external to the provincial government. This approach will build on the strengths of traditional regulation, but integrate it with a broader, more comprehensive approach to the environment.

The public and government need assurance that the desired outcomes and results are being achieved. Performance measures will be used to assess whether or not established outcomes (provincial and local) and policies have been met, and the relative success of government initiatives and programs. Goals, objectives, and performance targets will be jointly developed and continuously improved with other ministries, levels of government, the regulated community, NGO's, aboriginal groups and the general public and will be enshrined in legislated government wide plans.

The pulp and paper sector is one of the largest sources of industrial wastewater releases to the environment in Alberta. The control of the releases is essential for achieving the three outcomes for water as outlined in the provincial *Water for Life* (2003) strategy; maintaining the aquatic health of ecosystems, ensuring safe, secure drinking water supplies, and reliable water supplies for a sustainable economy. The purpose of this document is to provide the technology basis for wastewater release standards for the pulp and paper industry. These standards are required to ensure the industry applies the best possible controls to minimize substance release to the environment and help achieve the outcomes for water. The standards are the minimum requirements for pulp and paper

mill wastewater releases. More stringent standards may be applied, on a site-specific basis, to maintain water quality objectives.

1.3 The Delivery Tool

In Alberta, the *Environmental Protection and Enhancement Act* (EPEA) and associated regulations are the principal legislation (delivery tool) governing the environmental aspects of pulp and paper mill developments. Section 14(4) of the EPEA establishes the authority to develop guidelines and objectives to meet goals and purposes to which environmental protection efforts are directed.

Under the EPEA legislation, all new pulp, paper, newsprint or recycled fiber mills with a capacity of more than 100 tonnes/day are required to prepare an Environmental Impact Assessment report (Alberta Regulation 111/93 - *Environmental Assessment (Mandatory and Exempted) Regulation*). Also, all "pulp" and "pulp and paper" manufacturing plants are required to obtain an approval for construction, operation and reclamation (Alberta Regulation 211/96 - *Activities Designation Regulation*). The approval is the primary tool for applying the wastewater standards outlined in this document. Table 2 provides a brief overview of the fundamental principles of the EPEA approval and compliance process.

Table 2: Fundamental Principles of the EPEA Approval and Compliance Process

Principle	Comment
Life cycle control	Approvals are for the construction, operation and reclamation of activities
Wastewater standards and environmental quality objectives	Wastewater standards are based on the more stringent of best available technology economically achievable or that required to meet ambient environmental quality objectives.
Public involvement	The public has the opportunity to review and provide input into approvals, and has access to approval-related information
Right of Appeal	The legislation establishes a formal appeal mechanism and Appeal Board for both approval holders and directly affected parties
Compliance/Enforcement	The legislation empowers the government to inspect and monitor the operations of pulp mills to assess performance against approval requirements The legislation establishes a wide range of administrative and judicial measures for ensuring compliance with requirements

2.0 Standards Development

2.1 Policy: Standard Setting and Translation to Approval Limits

The objectives of Alberta Environment's approach to setting wastewater release standards are to ensure water quality objectives are maintained, that appropriate pollution prevention and control technologies are adopted so that substance releases to receiving waters are minimized. Two standards are developed to assess the limit that should be applied in an approval: one standard is based on best available technology economically achievable, and the second is based on maintaining water quality objectives. The technology-based standard is the minimum effort required. However, on a site-specific assessment, if the result of the two standards shows that the water quality based standard is more stringent, then this result is applied to the plant as the end of pipe release requirement in the approval (see the *Industrial Release Limits Policy*⁽¹⁾).

2.2 Delivery: Applying the Standards to determine Approval Limits

The standards outlined in Table 3 are used to determine the limits that are set in an individual plant approval. Where the standard is an intensity number (i.e. 2.5 kg/tonne for BOD₅), the standard is multiplied by the Reference Production Rate (RPR) to establish the approval limit. The RPR is defined as the highest value of the 90th percentiles of the daily production of finished product at a mill for any of the previous three years (*Pulp and Paper Effluent Regulations*⁽²⁾). The RPR is used in order to harmonize with federal reporting requirements on production and to ensure the maximum sustainable production rate is factored in. The RPR is only used at the time of approval issuance to set release limits that are technology based. The water quality based assessment will determine the total allowable loading to meet water quality objectives.

2.3 Place-based: Water Quality Based Standards

Water quality based standards are derived by calculating how much of a given substance can be released while still meeting instream surface water quality objectives⁽³⁾. For details please consult the *Water Quality Based Effluents Limits Procedures Manual*⁽⁴⁾. As an example, Alberta Environment is evaluating the need to set more stringent release limits on BOD for mills releasing to the Athabasca River based on water quality assessments on in-stream dissolved oxygen. These assessments are designed to establish the maximum level of BOD₅ that can be released into the river without risking maintenance of the acute dissolved oxygen (DO) objective of 5 mg/L and the chronic dissolved oxygen objective of 6.5 mg/L. For the Peace River, water quality concerns are not an issue due to the high average flows and water quality of the river relative to the wastewater releases. The technology approach is more stringent in this situation.

The development of water quality based standards considers the potential inaccuracy of model predictions and compensates for this through the use of conservative assumptions. For example, the BOD₅ release standards are developed to maintain the acute and chronic DO objectives under ice cover with no re-aeration potential (except in open water leads), low flow conditions, and all mills releasing at their daily maximum approval limits simultaneously.

2.4 Continuous Improvement: Technology-Based Standards

Technology-based standards are designed to facilitate the use of known, effective, demonstrated pollution prevention and control technologies. The release standards for new and existing pulp mills in Alberta were adopted after evaluation of technologies and wastewater treatment systems for Alberta pulp and paper mills, and top performing mills throughout the United States and Europe (see Appendix 1). The data for European mills are performance expectations and do not represent the regulatory standards that may be applied. For pulp and paper mills in Alberta, the basis for the technology-based limits is Best Available Technology Economically Achievable (BATEA). The BATEA for parameters that are regulated are summarized in Table 3.0 and described in Section 3.0.

3.0 Technology Standards

The main parameters regulated for control of wastewater quality for the pulp and paper industry in Alberta are biochemical oxygen demand (BOD₅), total suspended solids (TSS), adsorbable organic halides (AOX), colour, acute toxicity, and pH. Table 3 summarizes the BATEA based wastewater release standards.

Table 3: BATEA Wastewater Release Standards for New and Existing Mills

Substance	Pulp Mills Technology Pre 1992		Pulp Mills Technology after 1992 (Includes New and Modified mills)	
	Monthly Average Daily ⁽ⁱ⁾ (kg/ADt)	Maximum Daily ⁽ⁱⁱ⁾ (kg/ADt)	Monthly Average Daily (kg/ADt)	Maximum Daily (kg/ADt)
BOD ₅	2.5	5.0	1.5	3.0
TSS	4.0	8.0	3.0	6.0
AOX (Kraft Mills only)	0.5	1.0	0.5	1.0
Colour	See section 3.4 on application			
Dioxins & Furans (Kraft Mills only)	Non-measurable (see Table 8)		Non-measurable (see Table 8)	
Acute Toxicity	≥50% trout survival in 100% concentration test sample			
pH	6.0 to 9.5 pH Units			

• ADt – Air Dried Metric Tonne

⁽ⁱ⁾ The value that is not to be exceeded as determined by the arithmetic average of all daily determinations of mass, concentration or as specified during any month.

⁽ⁱⁱ⁾ The value not to be exceeded by any daily determination of mass

Table 3 includes wastewater release standards that will be applied to any new pulp and paper mill built after 1992, or any mill that is significantly modified after December 31, 2004. These standards are considered achievable for new plants based on the performance of the best pulp mills in the world. The delivery agency will determine the application of these standards to plants that modify their operations. The following sections describe the technical basis for the main regulated parameters (BOD, TSS, AOX, Colour) specific to pulp mill operations as outlined in Table 3.

Alberta Environment considers the following technologies as constituting BATEA for pulp mills in Alberta:

- ◆ Dry debarking
- ◆ Adequate control of chip thickness
- ◆ Closed screening
- ◆ Effective brownstock washing
- ◆ Steam stripping
- ◆ In-plant spill collection
- ◆ Recycling of wastewater
- ◆ Primary clarification
- ◆ Secondary biological wastewater treatment

- ◆ For Kraft mills specifically:
 - Elemental chlorine free or total chlorine free bleaching
 - Extended delignification (extended cooking or oxygen delignification)
 - Use of dioxin and furan precursor-free defoamers.

3.1 Biochemical Oxygen Demand (BOD₅)

BOD is defined as "the amount of oxygen required by living organisms engaged in the utilization and stabilization of organic matter present in the wastewater during a certain time period (five days for Alberta)"⁽⁵⁾. BOD is a concern as the breakdown of organic matter can result in a shortage of oxygen available to aquatic ecosystems in receiving

Table 4 lists the actual annual average emission intensity (2003) for pulp and paper mills in Alberta, the Canadian Federal Standards, New Source Performance Standards (NSPS) in the U.S., and performance of Best Available Technology in Europe.

Table 4: Actual Annual Average (2003) for Pulp and Paper Mills in Alberta, Canadian Federal Standards, U.S. Standards, and BAT in Europe

Parameter	Actual annual average of all Alberta pulp mills	Canada's Federal Standard (monthly maximum)	NSPS for the U.S. (monthly maximum)	U.S. Standards for mills discharging prior to 1998 (monthly average)	BAT for Europe* (annual averages)
BOD ₅ (kg/ADt)	0.77	7.5	2.4 ⁽ⁱ⁾ /2.5 ⁽ⁱⁱ⁾	5.5 ⁽ⁱ⁾	1.5 ⁽ⁱ⁾ /1.0 ⁽ⁱⁱ⁾ /0.5 ⁽ⁱⁱⁱ⁾

⁽ⁱ⁾ Bleached Kraft Mills

⁽ⁱⁱ⁾ CTMP Mills

⁽ⁱⁱⁱ⁾ TMP Newsprint Mills

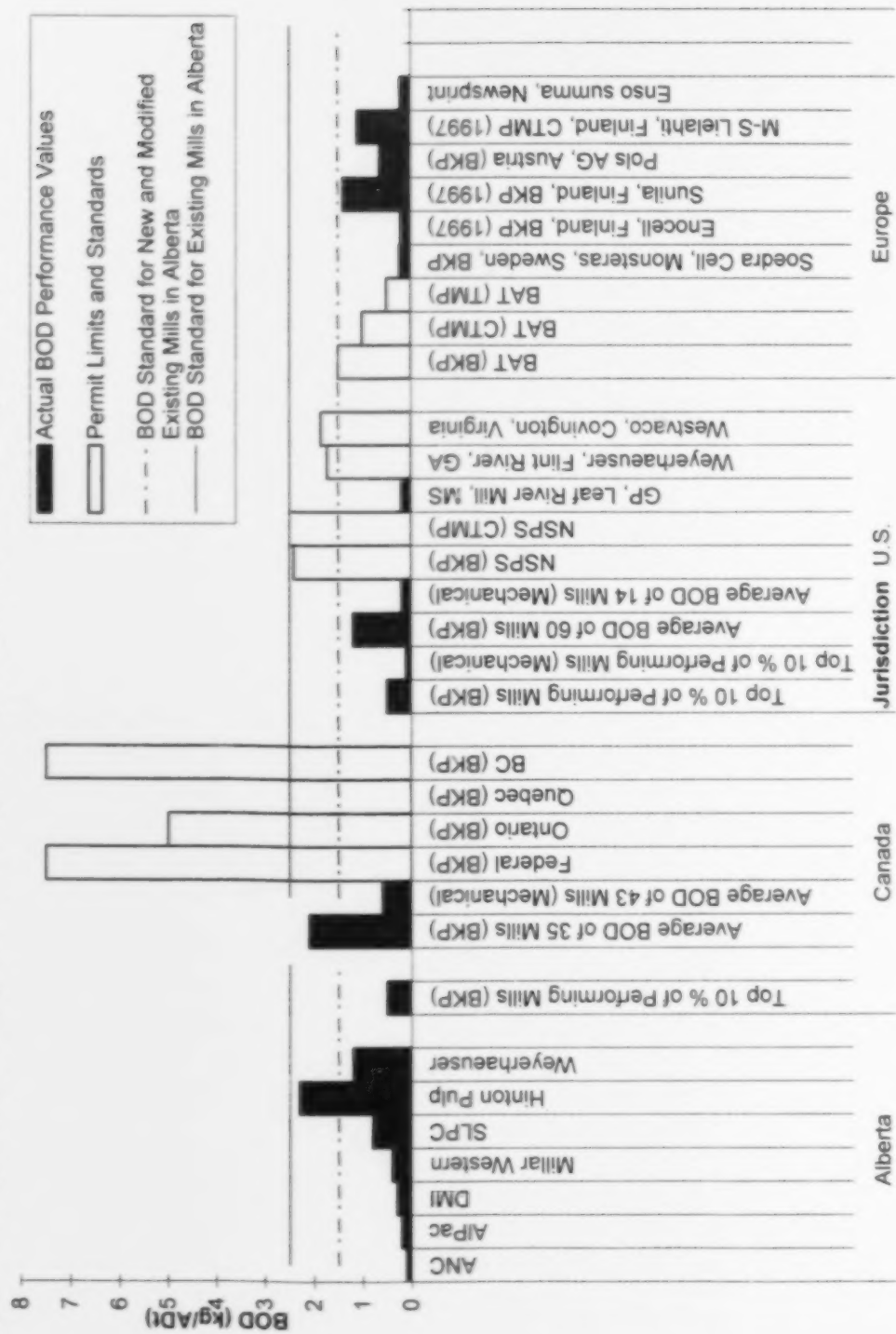
*Actual performance expectation

The methodology used to calculate the Alberta BOD₅ release rate can be found in Appendix 2. The Biochemical Oxygen Demand (BOD₅) standard identified in the USEPA Cluster Rules for New Source Performance Standards (NSPS) is the benchmark for existing mills, as Alberta mills currently apply the technology required to achieve this standard. This was based on a review of the current performance values for Alberta mills, other Canadian mills, top performing mills in the U.S., and allows for sufficient flexibility for plant operations during shutdown, start-up and upset conditions. Alberta's standards for BOD₅ are a monthly average of 2.5 kg/ADt and daily maximum of 5.0 kg/ADt for existing mills. These standards will be applied at approval renewal.

The Alberta-Pacific Forest industries (Al-Pac) pulp mill is considered the benchmark for new mills. Alberta's standards for BOD₅ are a monthly average of 1.5 kg/ADt and daily maximum of 3.0 kg/ADt for new mills built after 1992.

Figure 1 presents Alberta's standards in comparison to the actual performance values of mills in Alberta, Canada, Europe and the U.S., and various standards and permit limits used for some top performing mills.

Figure 1. Comparison of BOD₅ Values for Pulp and Paper Mills in Canada, Europe and the United States



3.2 Total Suspended Solids (TSS)

TSS is "a measurement of the dry mass of solids, which are retained on a specific filter after filtration."⁽⁶⁾ TSS is directly attributable to several water quality concerns, such as turbidity (reduced photosynthesis), sediment loading, aesthetics, and decreased recreational use.

Table 5 lists the actual annual average emission intensity (2003) for pulp and paper mills in Alberta, the Canadian Federal Standards, NSPS in the U.S., and the BAT in Europe.

Table 5: Actual Annual Average (2003) for Pulp and Paper Mills in Alberta, Canadian Federal Standards, U.S. Standards, and BAT in Europe

Parameter	Actual annual average of all Alberta pulp mills	Canada's Federal Standard (monthly maximum)	NSPS for the U.S. (monthly maximum)	U.S. Standards for mills discharging prior to 1998 (monthly average)	BAT for Europe* (annual averages)
TSS (kg/ADt)	1.6	11.25	3.86 ⁽ⁱ⁾ /4.6 ⁽ⁱⁱ⁾ /3.8 ⁽ⁱⁱⁱ⁾	11.9 ⁽ⁱ⁾	1.5 ⁽ⁱ⁾ /1.0 ⁽ⁱⁱ⁾ /0.5 ⁽ⁱⁱⁱ⁾

⁽ⁱ⁾ Bleached Kraft Mills

⁽ⁱⁱ⁾ CTMP Mills

⁽ⁱⁱⁱ⁾ TMP Newsprint Mills

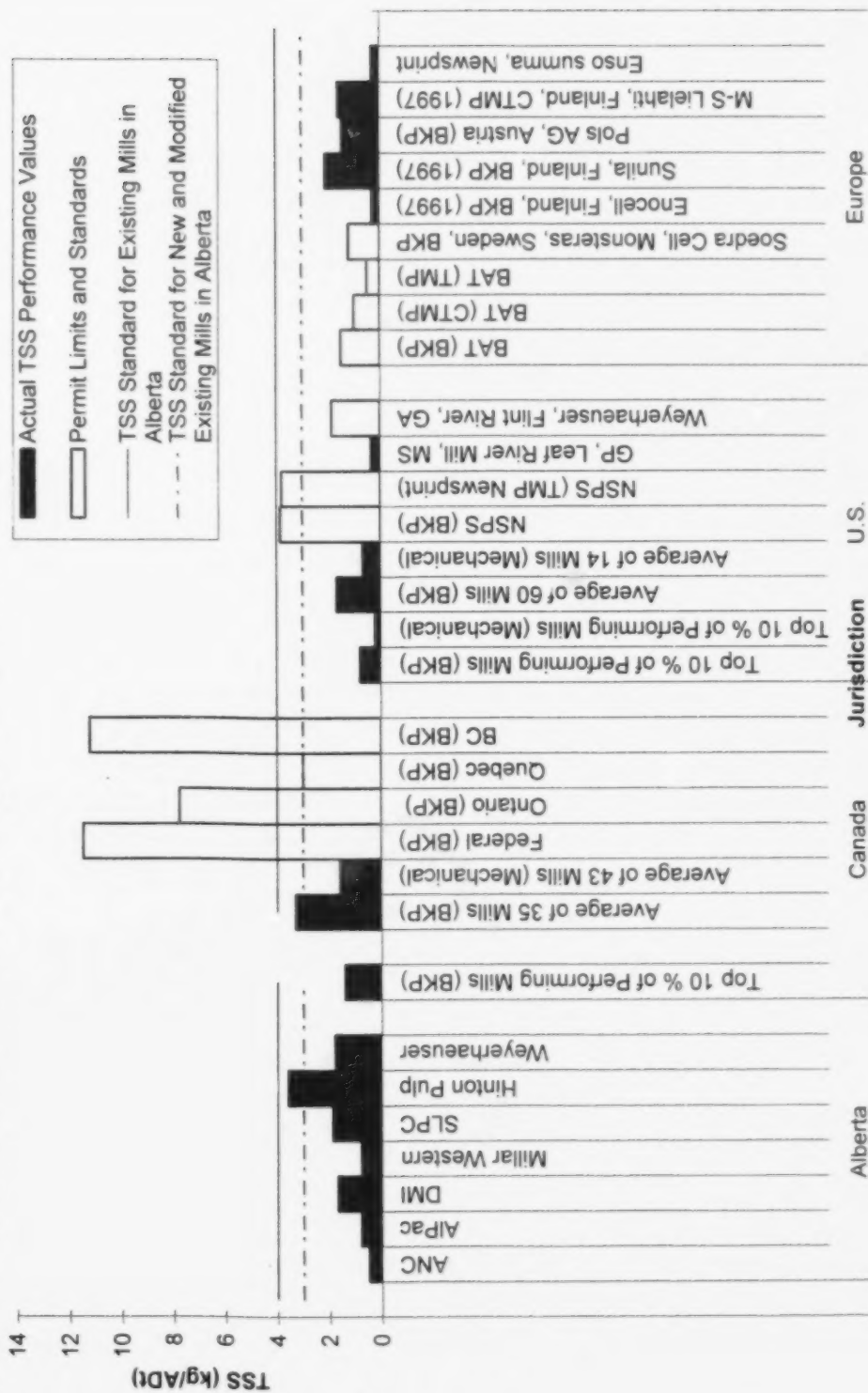
*Actual performance expectation

The Total Suspended Solids (TSS) standard identified in the USEPA Cluster Rules for New Source Performance Standards (NSPS) is the benchmark for existing mills, as Alberta mills currently apply the technology required to achieve this standard. This was based on a review of the current performance values for Alberta mills, other Canadian mills, top performing mills in the U.S., and allows for sufficient flexibility for plant operations during shutdown, start-up and upset conditions. Alberta's standards for TSS are a monthly average of 4.0 kg/ADt and daily maximum of 8.0 kg/ADt for existing mills. These standards will be applied at approval renewal.

The Al-Pac pulp mill is considered the benchmark for new mills. Alberta's standards for TSS are a monthly average of 3.0 kg/ADt and daily maximum of 6.0 kg/ADt for new mills built after 1992.

Figure 2 presents Alberta's standards in comparison to the actual performance values of mills in Alberta, Canada, Europe and the U.S., and various standards and permit limits used for some top performing mills.

Figure 2: Comparison of TSS Values for Pulp and Paper Mills in Canada, Europe and the United States



3.3 Adsorbable Organic Halide (AOX)

AOX is defined "as the amount of chloride, bromide or iodide bound to dissolved or suspended organic material"⁽⁷⁾. AOX standards are applied typically to kraft mills only due to their use of chlorine for bleaching. AOX measurements are used to assess the toxicity of the wastewater stream and to assess treatment system performance.

Table 6 lists the actual annual average emission intensity (2003) for Kraft pulp and paper mills in Alberta, NSPS in the U.S., and the BAT in Europe.

Table 6: Actual Annual Average (2003) for Pulp and Paper Mills in Alberta, U.S. Standards, and BAT in Europe

Parameter	Actual annual average of all Alberta pulp mills	NSPS for the U.S. (monthly maximum)	U.S. Standards for mills prior to 1998 (monthly average)	BAT for Europe* (annual averages)
AOX (kg/ADt)	0.1	0.272 ⁽¹⁾	0.623 ⁽¹⁾	<0.25/ ⁽²⁾ <0.01 ⁽²⁾

⁽¹⁾ Bleached Kraft Mills

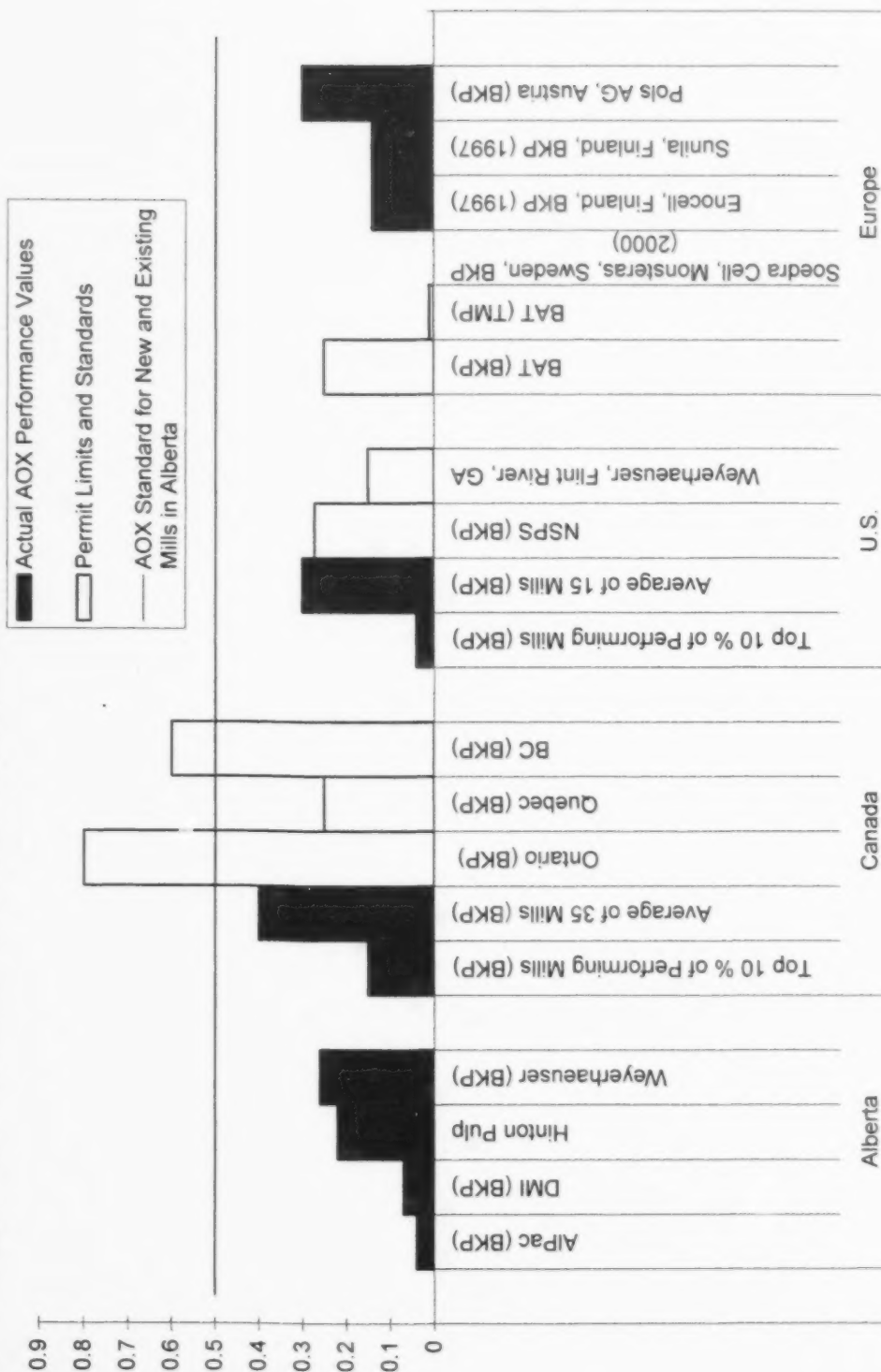
⁽²⁾ CTMP Mills

*Actual performance expectation

Based on a review of the current performance values for Alberta mills, other Canadian mills, and top performing mills in the U.S. and to allow sufficient flexibility for plant operations during shutdown, start-up and upset conditions, Alberta's standards for AOX are a monthly average of 0.5 kg/ADt and a daily maximum of 1.0 kg/ADt for both new and existing mills. The values are applicable at approval renewal for existing pulp and paper mills, and applied directly to any new mills.

Figure 3 presents Alberta's standard in comparison to the actual performance values of mills in Alberta, Canada, Europe and the U.S., and various standards and permit limits used for some top performing mills.

Figure 3: Comparison of AOX Values for Pulp and Paper Mills in Canada, Europe and the United States



3.4 Colour

Colour is defined "as the absorption of light at a specific wavelength in a filtered wastewater sample. The colour is expressed in arbitrary colour units. One colour unit is equivalent to the absorption of light by 1mg/L platinum in a platinum-cobalt solution"⁽⁹⁾ (i.e. wastewater with 20 colour units is "darker" than one that is measured with 10 colour units). Aesthetics and light absorption (reduced photosynthesis) are two main concerns with wastewater colour.

Table 7 lists the actual annual average emission intensity (2003) for pulp and paper mills in Alberta and the actual performance of some top mills in Canada and the U.S.

Table 7: Actual Annual Average (2003) for Pulp and Paper Mills in Alberta, and the Actual Performance of the Top Mills in Canada and the U.S.

Parameter	Actual annual average of all Alberta pulp mills	Actual Performance of the Top Mills in Canada	Actual Performance of the Top Mills in the U.S.
Colour (kg/ADt)	23.7	10.9 ⁽ⁱ⁾	39.3 ⁽ⁱⁱ⁾

⁽ⁱ⁾Top 10 % of mills in Canada

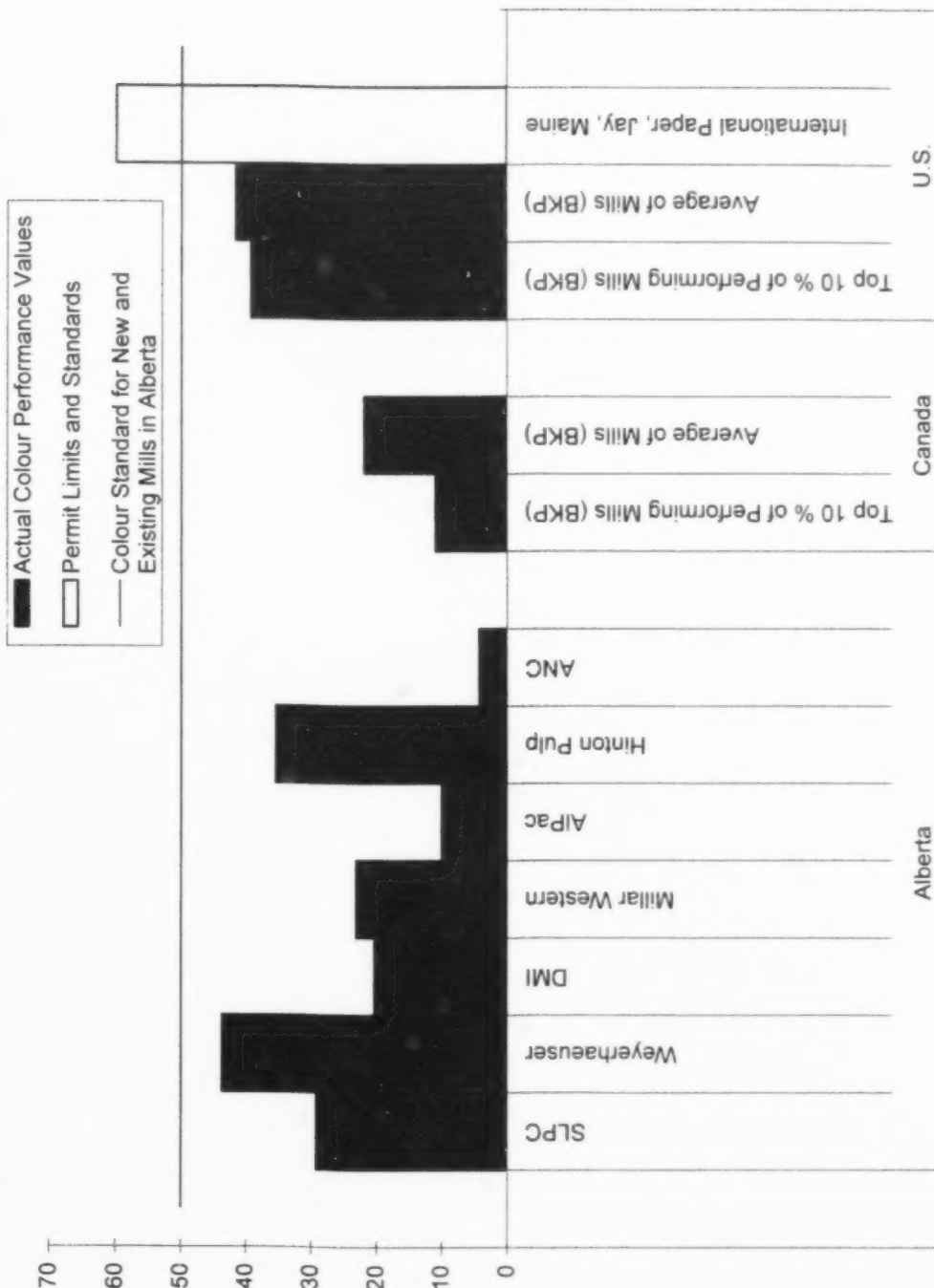
⁽ⁱⁱ⁾Top 10 % of mills in the U.S.

The review of other jurisdictions indicated that there was no jurisdiction that regulated pulp mills for colour on a technology basis. Available literature indicates application of the BATEA outlined in section 3.0 to minimize BOD and AOX releases will also result in minimization of colour to 50 kg/ADt or less. However, Alberta Environment requires colour standards for any newly constructed pulp and paper mill until the mill can demonstrate consistent wastewater colour levels below the colour standards. This is to verify optimal performance of the technology to minimize colour levels. Existing mills that have implemented BATEA and have optimized the performance such that they demonstrate consistent wastewater colour levels below 50 kg/ADt may be exempt from the release standards. Colour limits may also be applied on a site-specific level based on water quality concerns

Based on a review of the current performance values for Alberta mills, other Canadian mills, and top performing mills in the U.S. and to allow sufficient flexibility for plant operations during shutdown, start-up and upset conditions, Alberta's standards for colour are a monthly average of 50 kg/ADt and a daily maximum of 100 kg/ADt for both new and existing mills. The values may be applied at approval renewal for existing pulp and paper mills, and applied directly to any new mills.

Figure 4 presents the performance of Alberta's pulp mills in comparison to the actual performance values of mills in Canada, the U.S., and a permit limit used at one mill.

Figure 4: Comparison of Colour Values of Pulp and Paper Mills in Alberta, Canada, and the United States



Note: There are currently no technology-based standards for colour in Europe.

3.5 Dioxins and Furans

"The *Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations* require all Canadian pulp and paper mills using chlorine bleaching to ensure that dioxins and furans in their effluents are not measurable" ⁽¹⁰⁾. All Alberta mills meet this requirement.

3.6 Toxicity and pH

These requirements are standard for all industrial wastewater releases in Alberta.

3.7 Industrial Wastewater Monitoring Requirements

Table 4 summarizes the typical wastewater monitoring applied to release parameters with approval limits.

Table 8: Industrial Wastewater Monitoring Requirements

Parameter	Frequency	Sample Type	Sampling Location
BOD ₅	prior to release	Grab	2
	3/week	composite	1
TSS	prior to release	Grab	2
	1/day	composite	1
AOX	1/week	composite	1
Colour	1/week	composite	1
Acute Lethality	⁽¹⁾	grab or composite	1
Dioxins & Furans	⁽²⁾	composite	1
pH	prior to discharge	grab	2
	continuous	recorder	1
Flow	release event	estimate	2
	continuous	recorder	1

⁽¹⁾ For the measurement of Acute Lethality, the owner or operator must at least once per calendar month perform a 96-hour static acute bioassay using rainbow trout as the test organism on grab or composite samples collected from the wastewater.

⁽²⁾ Dioxins and furans are sampled, preserved, analysed, and reported according to the *Reference Method for the Determination of Polychlorinated Dibenzo-para-dioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) in Pulp Mill Effluents*, (Environment Canada) Report EPS 1/RM/19, 1991, as amended; and the *Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations* under the *Canadian Environmental Protection Act*.

Legend for sampling locations as designated in Table 8:

1 = the wastewater, prior to mixing with the receiving water

2 = the stormwater and chip and log storage runoff ponds

4.0 References

1. *Industrial Release Limits Policy*, November 2000, Alberta Environment.
2. *Pulp and Paper Effluent Regulations*, May 1992, Department of Fisheries and Oceans.
3. *Surface Water Quality Guidelines for Use in Alberta*, 1999, Alberta Environment.
4. *Water Quality Based Effluent Limits Procedures Manual*, 1995, Alberta Environment.
5. *Environmental Performance, Regulations and Technologies in the Pulp and Paper Industry*, June 2002, EKONO/Duoplan Strategic Study
6. Ibid.
7. Ibid.
8. *Integrated Pollution Prevention and Control (IPPC) – Reference Document on Best Available Techniques in the Pulp and Paper Industry*, December 2001, European Commission
9. *Environmental Performance, Regulations and Technologies in the Pulp and Paper Industry*, June 2002, EKONO/Duoplan Strategic Study
10. *Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations*, Canadian Environmental Protection Act, May 1992, Department of the Environment

Appendix 1

Pulp Mill Wastewater Treatment Technology Review

The following sections review pulp mill wastewater treatment technologies, wastewater quality generated, and standards or permit limits applied in other jurisdictions. Comparison to Alberta is also provided.

1) European Countries

(Source: Integrated Pollution Prevention and Control (IPPC) – Reference Document on Best Available Techniques in the Pulp and Paper Industry, December 2001, European Commission)

Basis for all types of mills:

During the information exchange among countries, they concluded that the most effective measure for the reduction of emissions/consumption and the improvement of economic performance is the implementation of the best available process and abatement technologies (BAT) in combination with the following:

- Training, education and motivation of staff and operators;
- Process control optimization;
- Sufficient maintenance of the technical units and the associated abatement techniques;
- Environmental management system, which optimizes management, increases awareness and includes goals and measures, process and job instruction.

a) Bleached Kraft Mills

BAT for Kraft pulp processing:

- Dry debarking of wood;
- Increased delignification before the bleach plant by extended or modified cooking and additional oxygen stages;
- Highly efficient brown stock washing and closed cycle brown stock screening;
- Elemental chlorine free (ECF) bleaching with low AOX or Totally chlorine free (TCF) bleaching;
- Recycling of some, mainly alkaline process water from the bleach plant;
- Effective spill monitoring, containment and recovery system;
- Stripping and reuse of the condensates from the evaporation plant;
- Sufficient capacity of the black liquor evaporation plant and the recovery boiler to cope with the additional liquor and dry solids load;
- Collection and reuse of clean cooling waters;

- Provision of sufficiently large buffer tanks for storage of spilled cooking and recovery liquors and dirty condensates to prevent sudden peaks of loading and occasional upsets in the external wastewater treatment plant;
- In addition to process-integrated measure, primary treatment and biological treatment is considered BAT for Kraft pulp mills.

Achievable Performance:

For bleached Kraft pulp mills the BAT wastewater intensities to water that are associated with the use of a suitable combination of these techniques are the following (annual averages):

	Flow m ³ /ADt	BOD ₅ kg/ADt	TSS kg/ADt	AOX kg/ADt
Bleached Pulp	30-50	0.3-1.5	0.6-1.5	<0.25

Actual Performance:

Examples of **achieved** emission performance from existing Kraft pulp mills in Europe associated with the use of a suitable combination of best available techniques and biological treatment (annual averages):

Mill	Flow m ³ /ADt	BOD ₅ kg/ADt	TSS kg/ADt	AOX kg/ADt
Soedra Cell, Monsteras, Sweden (2000)	45	0.23	1.2 (Limit)	0
Treatment:	Activated sludge with long retention time (>2 d), TCF pulp			
Enocell, Finland (1997)	39	0.2	0.3	0.14
Treatment:	Activated sludge with 24 h retention + aerated pond			
Sunila, Finland (1997)	70	1.4	2.1	0.14
Treatment:	Activated sludge			
Pols AG, Austria	45.8	0.64	1.45	0.30
Treatment:	Activated sludge with 14 h retention			

* For Sweden and Finland, BOD values are given as BOD₇

b) Mechanical Mills (CTMP and TMP Newsprint)

BAT for Mechanical pulping and chemi-mechanical pulping:

- Dry debarking of wood;
- Minimization of reject losses by using efficient reject handling stages;
- Water recirculation in the mechanical pulping department;

- Effective separation of the water systems of the pulp and paper mill by use of thickeners;
- Counter-current white water system from paper mill to pulp mill depending on the degree of integration;
- Use of sufficiently large buffer tanks for storage of concentrated wastewater streams from the process (mainly for CTMP);
- Primary and biological treatment of the wastewaters, and in some cases also flocculation or chemical precipitation.

Achievable Performances:

For CTMP mills and integrated mechanical pulp and paper mills, the BAT wastewater intensities to water that are associated with the use of a suitable combination of these techniques are the following (annual averages):

	Flow m ³ /ADt	BOD ₅ kg/ADt	TSS kg/ADt	AOX kg/ADt
CTMP Mills	15-20	0.5-1.0	0.5-1.0	-
TMP Newsprint	12-20	0.2-0.5	0.2-0.5	<0.01

Actual performance:

Examples of **achieved** emission performance from existing mechanical pulp mills in Europe associated with the use of a suitable combination of best available techniques and biological treatment (annual averages):

Mill	Flow m ³ /ADt	BOD ₇ kg/ADt	TSS kg/ADt
M-S Lielähti, FI, CTMP (1997)	23	1.1	1.6
Treatment:	Activated sludge		
Enso summa, Newsprint	24	0.21	0.3
Treatment:	No information		

*Where emission or consumption levels "associated with best available techniques" are presented, this is to be understood as meaning that those levels represent the environmental performance that could be anticipated as a result of the application, in this sector, of the techniques described, bearing in mind the balance of costs and advantages inherent within the definition of BAT. However, they are neither emission nor consumption limit values and should not be understood as such.

2) United States

(Source: USEPA - Final Pulp and Paper Cluster Rule - Federal Register Notices for Final Air and Water Rules, 1998)

(Source: EKONO (2001) - Environmental Performance, Regulations and Technologies in the Pulp and Paper Industry)

Basis for all types of mills:

a) Bleached Kraft Mills

BAT for bleached kraft mill pulp processing:

- Adequate control of chip thickness
- Close screening
- Use of dioxin and furan precursor-free defoamers
- Effective brownstock washing, with a target of less than 10 kg Na₂SO₄ carryover to bleaching per air-dry metric ton of pulp (99% wash yield)
- Elimination of hypochlorite
- 100% ClO₂ substitution
- Oxygen and peroxide enhanced extraction
 - Strategies for minimizing kappa factor and dioxin and furan precursors in the brownstock pulp
 - High shear mixing during bleaching
 - Efficient biological wastewater treatment.

For new mills and mills that participate in the Voluntary Advanced Technology Incentives Program, the BAT also include, in addition to the above technologies, prebleaching extended delignification (oxygen delignification or extended cooking).

USEPA Wastewater Standards (NSPS)

	BOD₅ kg/ADt	TSS kg/ADt	AOX kg/ADt
Bleached Kraft ¹	2.41	3.86	0.272
CTMP	2.5	4.6	
TMP Newsprint	2.5	3.8	

¹ Standards apply to Bleached Kraft Pulp Mills that commence discharge after June 15, 1998. Existing mills prior to June 15, 1998, do not have to meet these limits unless specified by the applicable State permit.

Existing wastewater performance from Kraft Mills in the US (State Permits)

	BOD ₅ kg/ADt	TSS kg/ADt	AOX kg/ADt	Type of Wastewater Treatment
GP, Leaf River Mill, MS	0.2 (Actual)	0.35 (Actual)	N/A	Activated Sludge
Weyerhaeuser, Flint River, GA	1.72	1.86	0.15	(Project XL)
Westvaco, Covington, Virginia	1.85 (Prod. Cap: 2268 ADt/d)	7.5 (Prod. Cap: 2268 ADt/d)	0.623	
Georgia-Pacific, Palatka, FL (Prod. Cap: 1534 ADt/d)	June 1-Nov 30: 1.03	June 1-Nov 30: 1.48	0.623	900 acres of facultative and aerobic lagoons
	Dec 1-May 31: 2.12	Dec 1-May 31: 3.0		

Summary: Standards and performance

Bleached Kraft Mills

	Monthly Average Intensities (unless otherwise specified)			
	Flow m ³ /ADt	BOD ₅ kg/ADt	TSS kg/ADt	AOX kg/ADt
Europe ¹ (annual avg)	30-50	0.3-1.5	0.6-1.5	<0.25
USEPA ²		2.41	3.86	0.272
Canada		7.5	11.5	-
Alberta		1.5-3.0	3.0-5.0	0.55-1.5
BC		7.5	11.25	0.6
Ontario		5.0	7.8	0.8
Quebec ³		2.5	3.0	0.25
Average of Actual Performance Levels From Alberta Kraft Mills From 1998-2002 (Annual Averages)				
Weldwood	99.7	2.2	3.0	0.21
Alberta Pacific	44.2	0.12	0.92	0.046
Weyerhaeuser	65.8	1.3	1.8	0.42
Daishowa	50.6	0.5	2.1	0.17

Mechanical Mill (CTMP and TMP Newsprint)

	Monthly Average Intensities (unless otherwise specified)			
	Flow m ³ /ADt	BOD ₅ kg/ADt	TSS kg/ADt	AOX kg/ADt
Europe: CTMP ¹ (annual avg)	15-20	0.5-1.0	0.5-1.0	-
Europe: TMP Newsprint ¹ (annual avg)	12-20	0.2-0.5	0.2-0.5	<0.01
USEPA: CTMP		2.5	4.6	-
USEPA: TMP Newsprint		2.5	3.8	-
Average of Actual Performance Levels From Alberta Mechanical Mills From 1998-2002 (Annual Averages)				
Slave Lake Pulp (CTMP)	19.3	1.1	1.76	-
Millar Western (CTMP)	19.2	0.54	1.2	-
ANC (TMP Newsprint)	26.1	0.12	0.48	-

* Values for Canada and the listed provinces are the same as the Kraft mill limits.

¹ Considered **achievable performance** based on the use of a combination of biological treatment and best available techniques (BAT).

² NSPS for mills commencing discharge after June 15, 1998.

³ For mills built after October 22, 1992.

Appendix 2

Calculating Actual 2003 Average Wastewater Parameters for Alberta's Pulp and Paper Sector

The following section provides the methodology used to calculate the average wastewater parameter release rates for BOD, TSS, AOX and Colour.

The average wastewater parameter release rates (e.g. TSS (kg/day)) were calculated by taking an arithmetic average of all releases in 2003. The production value (ADt/day) was calculated in the same fashion.

The average wastewater intensity (kg/ADt), for each parameter, was calculated by dividing the average wastewater parameter release rate (kg/day) by the average production value (ADt/day).

e.g. $\text{Average TSS Release Rate in 2003 (kg/day)} / \text{Average Production in 2003 (ADt/day)}$
= Average TSS Wastewater Intensity in 2003 (kg/ADt)



